4-22-05

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	10/602,938
Filing Date	June 24, 2003
First Named Inventor	Thompson M. Sloane
Art Unit	3748
Examiner Name	Zelalem Eshete
Total Number of Pages in This Submission	
Attorney Docket Number	GP-303216 (8540R-000038)

ENCLOSURES ***(check all that apply)***

- ☒ Fee Transmittal Form
  - ☐ Fee Attached
- ☐ Amendment / Reply
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Response to Missing Parts/ Incomplete Application
  - ☐ Response to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert to a Provisional Application
- ☐ Power of Attorney, Revocation Change of Correspondence Address
- ☐ Terminal Disclaimer
- ☐ Request for Refund
- ☐ CD, Number of CD(s) ____
- ☐ After Allowance Communication to Technology Center (TC)
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☒ Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- ☐ Proprietary Information
- ☐ Status Letter
- ☒ Other Enclosure(s) *(please identify below)*:
  return receipt postcard

Remarks

EV 570 165 040 US

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm or Individual name	Harness, Dickey & Pierce, P.L.C.	Attorney Name Michael D. Wiggins	Reg. No. 34,754
Signature			
Date	April 21, 2005		

CERTIFICATE OF TRANSMISSION/MAILING

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Signature		Date	April 21, 2005

PTO/SB/17 (12-04v2)
Approved for use through 07/31/2006. OMB 0651-0032
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Effective on 12/08/2004.
Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818).

FEE TRANSMITTAL for FY 2005

☐ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT	($) 500

Complete if Known	
Application Number	10/602,938
Filing Date	June 24, 2003
First Named Inventor	Thompson M. Sloane
Examiner Name	Zelalem Eshete
Art Unit	3748
Attorney Docket No.	GP-303216 (8540R-000038)

METHOD OF PAYMENT (check all that apply)

☐ Check ☐ Credit Card ☐ Money Order ☐ None ☐ Other (please identify) : _____

☒ Deposit Account Deposit Account Number: 07-0960 Deposit Account Name: General Motors Corporation

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

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FEE CALCULATION

1. BASIC FILING, SEARCH, AND EXAMINATION FEES

	FILING FEES		SEARCH FEES		EXAMINATION FEES		
		Small Entity		Small Entity		Small Entity	
Application Type	Fee ($)	Fee($)	Fee($)	Fee($)	Fee($)	Fee($)	Fees Paid ($)
Utility	300	150	500	250	200	100	____
Design	200	100	100	50	130	65	____
Plant	200	100	300	150	160	80	____
Reissue	300	150	500	250	600	300	____
Provisional	200	100	0	0	0	0	____

2. EXCESS CLAIM FEES

Fee Description	Fee ($)	Small Entity Fee ($)
Each claim over 20 (including Reissues)	50	25
Each independent claim over 3 (including Reissues)	200	100
Multiple dependent claims	360	180

Total Claims	Extra Claims	Fee($)	Fee Paid ($)
____ -20 or HP=	0	x ____	= 0

HP = highest number of total claims paid for, if greater than 20.

Indep. Claims	Extra Claims	Fee($)	Fee Paid ($)
____ - 3 or HP=	0	x ____	= 0

HP = highest number of independent claims paid for, if greater than 3.

Multiple Dependent Claims	
Fee ($)	Fee Paid ($)
____	____

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof	Fee ($)	Fee Paid ($)
____ -	= 0	/ 50 = 0 (round **up** to a whole number) x		= 0

4. OTHER FEE(S)

	Fees Paid ($)
Non-English Specification, $130 fee (no small entity discount)	____
Other (e.g., late filing surcharge) : Filing appeal brief (#1402)	500

SUBMITTED BY

Signature	Michael D. Wiggins	Registration No. (Attorney/Agent) 34,754	Telephone 248-641-1600
Name (Print/Type)	Michael D. Wiggins		Date April 21, 2005

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Appeal No. _____

Application No.:	10/602,938
Filing Date:	June 24, 2003
Applicant:	Thompson M. Sloane
Group Art Unit:	3748
Examiner:	Zelalem Eshete
Title:	ACETYLENE-BASED ADDITION FOR HOMOGENEOUS-CHARGE COMPRESSION IGNITION (HCCI) ENGINE OPERATION
Attorney Docket:	GP-303216 (8540R-000038)

Mail Stop Appeal Brief - Patents
Director of The United States Patent and Trademark Office
P.O. Box 1450
Alexandria, Virginia 22313-1450

APPELLANT'S BRIEF

TABLE OF CONTENTS

BRIEF ON BEHALF OF APPELLANT

This is an appeal from the action of the Examiner dated September 10, 2004, finally rejecting claims 1 –17 and 20 – 35 and objecting to claims 18, 19 and 36. Copies of the claims appealed are attached as an appendix.

I. REAL PARTY IN INTEREST

The real party in interest in the present application is General Motors Corporation (Assignee).

II. RELATED APPEALS AND INTERFERENCES

There are presently no related appeals which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF THE CLAIMS

Claims 1 – 17 and 20 – 35 stand finally rejected. Claims 18, 19 and 36 stand objected to. The rejection of claims 1 – 17 and 20 – 35 is being appealed.

IV. STATUS OF AMENDMENTS

An After Final Amendment was filed on December 10, 2004 in response to the Final Office Action dated September 10, 2004. Copies of the claims appealed corresponding to the After Final Amendment are attached as an appendix.

V. SUMMARY OF CLAIMED SUBJECT MATTER

Claim 1 is directed to a method of operating a homogeneous-charge compression ignition (HCCI) engine. Claim 1 includes initiating fuel injection and concurrently initiating injection of an acetylene-based component into the engine (see Paras. [0022], [0023] and Figure 2), mixing air, the fuel and the acetylene-based component to form a combustion mixture (see Para. [0023] and Figure 2) and compressing the combustion mixture to induce auto-ignition of the combustion mixture, releasing energy and converting the combustion mixture to exhaust gas (see Para. [0023]).

Claim 13 is also directed to a method of operating an HCCI engine. Claim 13 includes initiating fuel injection and concurrently initiating injection of an acetylene-based component into the engine (see Paras. [0022], [0023] and Figure 2), controlling a supply of the acetylene-based component based on a load of the engine (see Para. [0029]) and controlling a supply of the fuel based on the load of the engine (see Para. [0027]). Claim 13 further includes mixing air, the fuel and the acetylene-based component to form a combustion mixture (see Para. [0023] and Figure 2) and compressing the combustion mixture to induce auto-ignition of the combustion mixture and convert the combustion mixture to exhaust gas (see Para. [0023]).

Claim 27 is directed to a vehicle that is driven by a homogeneous-charge compression ignition (HCCI) engine. Claim 27 includes a fuel supply that initiates injection of a hydrocarbon fuel in a first amount and an acetylene supply that concurrently initiates injection of an acetylene-based component in a second amount (see Paras. [0022], [0023], Figure 1 and Figure 2). Claim 27 further includes a cylinder having a piston reciprocally driven therein, the cylinder receiving a combustion mixture including a third amount of air,

the first amount of hydrocarbon fuel and the second amount of the acetylene-based component (see Para. [0023] and Figure 2). The piston compresses the combustion mixture to induce auto-ignition of the combustion mixture (see Para. [0023]).

VI. GROUNDS OF REJECTION TO BE REVIEWED

A. Whether the combination of Dahung (EP0643209) and Bundrick (US4419969) and further in view of Gonzalez (US4765293) establish a prima facie case of obviousness under 35 U.S.C. § 103(a), with respect to claims 1, 2, 8 – 14, 17, 20, 24 – 28, 34 and 35.

B. Whether the combination of Dahung (EP0643209) and Bundrick (US4419969) further in view of Gonzalez (US4765293) and further in view of Britton (US6314925), establish a prima facie case of obviousness under 35 U.S.C. § 103(a), with respect to claims 3, 15 and 29.

C. Whether the combination of Dahung (EP0643209) and Bundrick (US4419969) further in view of Gonzalez (US4765293) and further in view of Dickey (US5832880), establish a prima facie case of obviousness under 35 U.S.C. § 103(a), with respect to claims 4, 16 and 30 – 32.

D. Whether the combination of Dahung (EP0643209) and Bundrick (US4419969) further in view of Gonzalez (US4765293) and further in view of Bromberg et al. (US5409784), establish a prima facie case of obviousness under 35 U.S.C. § 103(a), with respect to claims 5, 6, 21, 22 and 33.

E. Whether the combination of Dahung (EP0643209) and Bundrick (US4419969) further in view of Gonzalez (US4765293) and further in view of Ethington (US4690743), establish a prima facie case of obviousness under 35 U.S.C. § 103(a), with respect to claims 7 and 23.

F. Whether the combination of Dahung (EP0643209) and Bundrick (US4419969) further in view of Gonzalez (US4765293) and further in view of Lowther et al. (US4965052), establish a prima facie case of obviousness under 35 U.S.C. § 103(a), with respect to claims 7 and 23.

VII. ARGUMENTS

A. The combination of Dahung (EP0643209) and Bundrick (US4419969) in view of Gonzalez (US4765293) does not render obvious the invention of claims 1, 2, 8 – 14, 17, 20, 24 – 28, 34 and 35.

As discussed in detail above, each of claims 1 and 13 include initiating fuel injection and concurrently initiating injection of an acetylene-based component into the engine, mixing air, the fuel and the acetylene-based component to form a combustion mixture and compressing the combustion mixture to induce auto-ignition of the combustion mixture. Dahung fails to teach or suggest concurrently initiating injection of a fuel and an acetylene-based component, mixing air, the fuel and the acetylene-based component to form a combustion mixture and compressing the combustion mixture to induce auto-ignition of the combustion mixture.

As discussed in detail in the Amendment filed on August 9, 2004, further clarified in the Amendment filed on December 10, 2004 and as indicated by the Examiner on Page 2 of the Final Office Action issued on September 10, 2004, Dahung fails to teach or suggest concurrently injecting a fuel and an acetylene-based component. Dahung specifically teaches that the main fuel is introduced into the combustion chamber prior to the pilot fuel under high load conditions. Under low load conditions, the pilot fuel is introduced into the combustion chamber prior to introducing the main fuel into the combustion chamber (see Abstract and Col. 2, Line 47 through Col. 3, Line 15). Therefore, Dahung fails to teach or suggest concurrent injection of the main fuel and the pilot fuel.

Bundrick fails to cure the deficient teachings of Dahung. More specifically, Bundrick simply discloses the use of a single fuel (not a main fuel and a pilot fuel), which can

include one of several types of fuel, including acetylene (see Col. 2, Lines 5 – 18). Because Bundrick fails to teach or suggest multiple fuels or concurrent injection of multiple fuels, Bundrick fails to cure the deficient teachings of Dahung.

Gonzalez also fails to cure the deficient teachings of Dahung. More specifically, Gonzalez discloses a hybrid internal combustion engine including a pre-combustion chamber or prechamber 19 having a pilot fuel injector 22 and a spark plug 24. The prechamber 19 connects with a cylinder 15 through a passage 20. The cylinder 15 slidably supports a piston 11 that includes a main combustion chamber recess or bowl 16 formed in a top surface thereof. (see Col. 4, Lines 21 – 50 and Figures 1 – 3).

In operation, the piston 11 compresses air to induce a swirling airflow pattern in the prechamber 19 (Col. 5, Lines 28 – 32). The pilot fuel injector 22 injects a pilot fuel into the prechamber 19 (Col. 5, Lines 33 – 35). The spark plug 24 ignites the pilot fuel within the prechamber 19 inducing a flow of hot exhaust from the prechamber 19 through the passage 22 and into the cylinder 15 and specifically into the main combustion chamber 16 (Col. 5, Lines 41 – 43 and Lines 51 – 54). A main fuel spray 29 is injected into the main combustion chamber 16 and is ignited therein as a result of the heat provided by the exhaust from the prechamber 19.

Gonzalez fails to cure the deficient teachings of Dahung on several points. Initially, Gonzalez is directed toward spark-ignition engines that include a spark plug to induce combustion. The system of Gonzalez is not applicable to compression ignition engines. Further, Gonzalez requires the pilot fuel to be ignited separately from the main fuel. As described in detail above and throughout the text of Gonzalez, the pilot fuel of Gonzalez is

combusted within the prechamber 19 prior to combustion of the main fuel. Therefore, Gonzalez separately combusts the fuels and does not create a combustion mixture.

Applicant further notes that one skilled in the art would not look to Gonzalez to supplement the deficient teachings of Dahung. More specifically, when applying references under 35 U.S.C. §103, the references must be considered as a whole and must suggest the desirability and thus the obviousness of making the combination (see MPEP §2141). There is no suggestion or motivation to combine the references because Gonzalez teaches away from Dahung. More specifically, Gonzalez requires the pilot fuel and main fuel to be separately injected into different combustion chambers and separately combusted. Dahung teaches that the pilot fuel and the main fuel are mixed and are combusted together. Therefore, the combination of Dahung and Gonzalez is improper.

In view of the foregoing, reconsideration and withdrawal of the rejections of claims 1 and 13 are respectfully requested.

Claims 2 and 8 – 12 ultimately depend from claim 1, which defines over the prior art as discussed in detail above. Therefore, claims 2 and 8 – 12 also define over the prior art for at least the reasons stated above with respect to claim 1, and reconsideration and withdrawal of the rejections are respectfully requested.

Claims 14, 17, 20 and 24 – 26 ultimately depend from claim 13, which defines over the prior art as discussed in detail above. Therefore, claims 14, 17, 20 and 24 – 26 also define over the prior art for at least the reasons stated above with respect to claim 13, and reconsideration and withdrawal of the rejections are respectfully requested.

As discussed above, claim 27 includes a fuel supply that initiates injection of a hydrocarbon fuel in a first amount, an acetylene supply that concurrently initiates injection

of an acetylene-based component in a second amount and a cylinder having a piston reciprocally driven therein, the cylinder receiving a combustion mixture including a third amount of air, the first amount of hydrocarbon fuel and the second amount of the acetylene-based component. Dahung fails to teach or suggest a fuel supply that initiates injection of a hydrocarbon fuel in a first amount, an acetylene supply that concurrently initiates injection of an acetylene-based component in a second amount and a cylinder having a piston reciprocally driven therein, the cylinder receiving a combustion mixture including a third amount of air, the first amount of hydrocarbon fuel and the second amount of the acetylene-based component.

Bundrick fails to cure the deficient teachings of Dahung and Gonzalez further fails to cure the deficient teachings of Dahung, as discussed in detail above with respect to claims 1 and 13. Therefore, claim 27 defines over the prior art and reconsideration and withdrawal of the rejection are respectfully requested.

Claims 28, 34 and 35 ultimately depend from claim 27, which defines over the prior art as discussed in detail above. Therefore, claims 28, 34 and 35 also define over the prior art for at least the reasons stated with respect to claim 27, and reconsideration and withdrawal of the rejections are respectfully requested.

With regard to the rejections of claims 1, 13 and 27 in general, the Examiner incorrectly relies on the general knowledge of one skilled in the art to combine the references. The facts and the holdings of these cases do not support the Examiner's conclusion under §103. In both In re Fine, 5 U.S.P.Q.2d, 1596 (CAFC 1988) and In re Jones, 21 USPQ.2d 1941 (Fed. Cir. 1992), the CAFC reversed the Board and the Examiner based upon the Examiner's unsupported reliance upon the general knowledge

of one skilled in the art. As in the instant case, the Examiners in both In re Fine and In re Jones combined features of two references in the same broad category of art and relied upon the general knowledge of one skilled in the art in making the combination. As in the instant case, the Examiners in In re Fine and In re Jones did not support the combinations by identifying specific teachings, suggestions or motivations found in the references.

Both In re Fine and In re Jones reject the proposition that the teaching, suggestion or motivation required by §103 is present simply because the references all relate to the same broad category of art or that unsupported general knowledge of one skilled in the art can be relied upon. The Examiner is essentially asserting that it would be obvious for skilled artisans to try the features of one device in another similar device. The CAFC expressly rejected the "obvious to try theory" in In re Fine at 1598.

In view of the foregoing, the combination of the references is improper and otherwise fail to teach or suggest all of the elements of the claim, as set forth. Therefore, Applicants respectfully request that this Board overturn the Examiner's rejection of claims 1, 13 and 27.

B. The combination of Dahung (EP0643209) and Bundrick (US4419969) in view of Gonzalez (US4765293) and further in view of Britton (US6314925) does not render obvious the invention of claims 3, 15 and 29.

Claims 3, 15 and 29 ultimately depend from one of claims 1, 13 and 27, which define over the prior art as discussed in detail above. Therefore, claims 3, 15 and 29 also define over the prior art for at least the reasons stated above with respect to claims 1, 13 and 27, and reconsideration and withdrawal of the rejections are respectfully requested.

C. The combination of Dahung (EP0643209) and Bundrick (US4419969) in view of Gonzalez (US4765293) and further in view of Dickey (US5832880) does not render obvious the invention of claims 4, 16 and 30 – 32.

Claims 4, 16 and 30 – 32 ultimately depend from one of claims 1, 13 and 27, which define over the prior art as discussed in detail above. Therefore, claims 4, 16 and 30 – 32 also define over the prior art for at least the reasons stated above with respect to claims 1, 13 and 27, and reconsideration and withdrawal of the rejections are respectfully requested.

D. The combination of Dahung (EP0643209) and Bundrick (US4419969) in view of Gonzalez (US4765293) and further in view of Bromberg et al. (US5409784) does not render obvious the invention of claims 5, 6, 21, 22 and 33.

Claims 5, 6, 21, 22 and 33 ultimately depend from one of claims 1, 13 and 27, which define over the prior art as discussed in detail above. Therefore, claims 5, 6, 21, 22 and 33 also define over the prior art for at least the reasons stated above with respect to claims 1, 13 and 27, and reconsideration and withdrawal of the rejections are respectfully requested.

E. The combination of Dahung (EP0643209) and Bundrick (US4419969) in view of Gonzalez (US4765293) and further in view of Ethington et al. (US4690743) does not render obvious the invention of claims 7 and 23.

Claims 7 and 23 ultimately depend from one of claims 1 and 13, which define over the prior art as discussed in detail above. Therefore, claims 7 and 23 also define over the prior art for at least the reasons stated above with respect to claims 1 and 13, and reconsideration and withdrawal of the rejections are respectfully requested.

F. The combination of Dahung (EP0643209) and Bundrick (US4419969) in view of Gonzalez (US4765293) and further in view of Lowther et al. (US4965052) does not render obvious the invention of claims 7 and 23.

Claims 7 and 23 ultimately depend from one of claims 1 and 13, which define over the prior art as discussed in detail above. Therefore, claims 7 and 23 also define over the prior art for at least the reasons stated above with respect to claims 1 and 13, and reconsideration and withdrawal of the rejections are respectfully requested.

VIII. CONCLUSION

In view of the above presented discussion, Applicants believe that the pending claims are patentably distinguishable over the art cited by the Examiner. Accordingly, Applicants respectfully request that this Board reverse the final rejection of claims 1 – 21.

Per the fee transmittal submitted herewith, Deposit Account No. 07-0960 has been charged the amount of $500 for filing the brief in support of this appeal. Please charge any deficiency or credit any overpayment pursuant to 37 C.F.R. § 1.16 or § 1.17 to Deposit Account No. 07-0960.

Respectfully submitted,

Dated: 4-21-2005

By: _____

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Enclosures: Three (3) copies of Appellant's Brief

RPM

APPENDIX

1. A method of operating a homogeneous-charge compression ignition (HCCI) engine, comprising:

initiating fuel injection and concurrently initiating injection of an acetylene-based component into said engine;

mixing air, said fuel and said acetylene-based component to form a combustion mixture; and

compressing said combustion mixture to induce auto-ignition of said combustion mixture, releasing energy and converting said combustion mixture to exhaust gas.

2. The method of claim 1 wherein said acetylene-based component consists essentially of acetylene.

3. The method of claim 1 wherein said acetylene-based component comprises acetylene and hydrogen.

4. The method of claim 1 wherein said combustion mixture further comprises engine exhaust.

5. The method of claim 1 further comprising producing said acetylene-based component using a plasma generator.

6. The method of claim 5 wherein said plasma generator uses a voltage and a frequency to produce said acetylene-based component.

7. The method of claim 1 further comprising producing said acetylene-based component with a thermal reactor.

8. The method of claim 1 further comprising drawing said combustion mixture into a cylinder of said HCCI engine.

9. The method of claim 1 wherein said step of mixing air, said fuel and said acetylene-based component occurs within a cylinder of said HCCI engine.

10. The method of claim 1 wherein based on 100 parts by weight of said fuel, said acetylene-based component constitutes up to 20 parts by weight of said fuel.

11. The method of claim 10 wherein said acetylene-based component constitutes at least 2 parts by weight of said fuel.

12. The method of claim 1 further comprising exhausting said exhaust gas.

13. A method of operating a homogeneous-charge compression ignition (HCCI) engine between a high load condition and a low load condition, comprising:

initiating fuel injection and concurrently initiating injection of an acetylene-based component into said engine;

controlling a supply of said acetylene-based component based on a load of said engine;

controlling a supply of said fuel based on said load of said engine;

mixing air, said fuel and said acetylene-based component to form a combustion mixture; and

compressing said combustion mixture to induce auto-ignition of said combustion mixture and convert said combustion mixture to exhaust gas.

14. The method of claim 13 wherein said acetylene-based component consists essentially of acetylene.

15. The method of claim 13 wherein said acetylene-based component comprises acetylene and hydrogen.

16. The method of claim 13 wherein said combustion mixture further comprises engine exhaust.

17. The method of claim 13,wherein said step of controlling a supply of said acetylene-based component comprises maintaining a consistent supply regardless of said load.

18. The method of claim 13 wherein said step of controlling a supply of said acetylene-based component comprises terminating said supply when said load is high.

19. The method of claim 13 wherein said step of controlling a supply of said acetylene-based component comprises increasing said supply as said load decreases.

20. The method of claim 13 wherein said step of controlling a mixture amount of said fuel comprises reducing said mixture amount as said load decreases.

21. The method of claim 13 further comprising producing said acetylene-based component using a plasma generator.

22. The method of claim 21 wherein said plasma generator uses an a voltage and a frequency to produce said acetylene-based component.

23. The method of claim 13 further comprising producing said acetylene-based component using a thermal reactor.

24. The method of claim 13 further comprising drawing said combustion mixture into a cylinder of said HCCI engine.

25. The method of claim 13 wherein said step of mixing air, fuel and said acetylene-based component occurs within a cylinder of said HCCI engine.

26. The method of claim 13 further comprising injecting an amount said acetylene-based component within a range of up to 20 weight % of said fuel.

27. A vehicle driven by a homogeneous-charge compression ignition (HCCI) engine, comprising:

a fuel supply that initiates injection of a hydrocarbon fuel in a first amount;

an acetylene supply that concurrently initiates injection of an acetylene-based component in a second amount; and

a cylinder having a piston reciprocally driven therein, said cylinder receiving a combustion mixture including a third amount of air, said first amount of hydrocarbon fuel and said second amount of said acetylene-based component, wherein said piston compresses said combustion mixture to induce auto-ignition of said combustion mixture.

28. The vehicle of claim 27 wherein said acetylene-based component consists essentially of acetylene.

29. The vehicle of claim 27 wherein said acetylene-based component comprises acetylene and hydrogen.

30. The vehicle of claim 27 wherein said combustion mixture further comprises engine exhaust.

31. The vehicle of claim 27 further comprising an inlet valve movable between an open position and a closed position, wherein when in said open position said inlet valve enables a flow of said combustion mixture into said cylinder.

32. The vehicle of claim 27 further comprising:

a fuel injector that selectively injects said first amount of said hydrocarbon fuel into said cylinder;

an acetylene injector that injects said second amount of said acetylene-based component into said cylinder; and

an inlet valve movable between an open position and a closed position, wherein when in said open position said inlet valve enables a flow of said third amount of said air into said cylinder to mix with said hydrocarbon fuel and said acetylene-based component to produce said combustion mixture.

33. The vehicle of claim 27 wherein said acetylene supply is a plasma generator that converts a portion of said hydrocarbon fuel to produce said second amount of said acetylene-based component.

34. The vehicle of claim 27 wherein said second amount of said acetylene-based component is up to 20 weight % of said fuel.

35. The vehicle of claim 27, wherein said second amount of said acetylene-based component varies based on a load of said HCCI engine.

36. The vehicle of claim 27, wherein said second amount of said acetylene-based component remains constant regardless of a load of said HCCI engine.